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Aging and Economic Growth: Issues Relevant to Singapore[†]

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Abstract

The paper studies the effects of the changing age and education composition of the labour force on productivity growth in Singapore. The quality change of workers from aging and education is measured through a quality index. Quality change through education is the key driving force for the productive performance of the labour force. On the other hand, the growth in the labour quality of workers by age, and hence, its contribution to labour productivity growth is falling. To moderate the impact of the aging labour force on productivity growth, greater efforts to raise the educational profile of the labour force and to re-train older workers are required.

JEL Classification: J24, O40

Executive Summary

Singapore's labour force is aging as a result of its aging population. This has implications on the competitiveness of Singapore's small and open economy, particularly if older workers do not contribute significantly to overall productivity growth in the economy. Given the rapid structural changes taking in the Singapore economy, the effects of an aging labour force on productivity growth may be even more pronounced in Singapore. This is because older workers, who may have invested heavily in job- or technology-specific skills, are likely to face a higher rate of depreciation of their skills in such an environment.

Given that the educational profile of the labour force is improving even as it ages, this paper studies the impact of both the changing age and educational composition of the workforce on productivity growth in Singapore. This is done through the construction of labour quality indices by the age and education characteristics of workers. Simulations on how changes in labour quality by age and education in the future can affect Singapore's productivity growth are also conducted, and policy implications are then drawn.

Overall, the results suggest that the growth in labour quality by age characteristics has declined rapidly from 0.82% in the pre-Asian crisis period of 1984-1997 to just 0.01% in the post-crisis period of 1998-2004. This is largely caused by the aging of the labour force, coupled with an increase in the depreciation rate of the technology-specific skills of workers across all ages in an environment of greater economic volatility during the post-crisis period. Of particular concern is the rising negative impact of workers in the 55 and above age group on labour quality and hence, labour productivity growth. On the other hand, the contribution of workers aged 40-54 to labour quality and productivity growth has overtaken that of younger workers. This could be partly attributed to the success of the Government's efforts

in re-training older, less educated workers so that they remain productive and relevant to the needs of the economy.

However, while the aging of the labour force has a significant impact on labour quality and productivity growth, the results clearly indicate that education is still the key driver of labour quality improvements and productivity growth in Singapore. Workers with degree education have been found to contribute the most to labour quality and labour productivity growth. This suggests that having a highly educated workforce will be crucial in helping Singapore to sustain its economic growth in the long term, especially as it moves towards a knowledge economy. Another interesting result is the improvement in the quality effect of the less educated workers, possibly due to the success of training and job re-design programmes put in place by the Government to enhance their productivity and employability. Worryingly though, the quality effect of the better educated workers, whilst still higher than that for the less educated workers, has declined over the years. This could be seen as a signal that even educated workers suffer from a faster rate of erosion of their human capital during periods of economic volatility.

Finally, the results from the simulations show that unless more is done to improve labour quality growth through education and/or to arrest the fall in the growth rate of labour quality by age, Singapore could see a decline in labour productivity growth in the years ahead as its labour force continues to age. This would adversely affect Singapore's economic competitiveness and growth.

Given the findings, the main policy implications are:

(i) To mitigate the negative impact of an aging labour force on labour productivity growth, it is important for the Government to continue to focus on life-long learning and the re-training of older and less educated workers, as this will help the workers

to remain relevant and productive in the domestic economy. Special attention may have to be given to workers aged 55 and above.

(ii) Given that education is the key driving force for labour quality improvements and productivity growth, the Government should continue to push ahead with its plans to raise the educational profile of Singaporeans, particularly in terms of increasing the number of tertiary graduates.

(iii) Although the Government's training efforts should rightly still be focused on the less educated and older workers, there may be a need to consider ways to encourage and help the better educated workers to keep their skills updated and relevant to the changing needs of the economy.

In conclusion, one of the key challenges facing Singapore now is how to manage the impact of an aging population on labour productivity, and hence, economic growth. This study has re-affirmed the need for the Government to focus on education and the training of older workers in order to enhance the labour force's productivity and employability.

1. Introduction

Many developed countries are faced with the economic and social challenges brought about by an aging population. Like these countries, Singapore too is experiencing the effects of an aging population as a result of its low fertility and mortality rates.[1] With an aging population, the age composition of the labour force tends to shift towards older workers. This aging of the labour force has important implications for the competitiveness of Singapore's small and open economy, particularly if older workers do not make a significant contribution to overall productivity growth in the economy. For instance, a higher ratio of older to younger workers could lead to high capital intensity in the economy, thus increasing the pressure on average wages. In an open economy, this would have a dampening effect on the competitiveness of exports and thus affect the long-term growth of the economy. The rising wages could, however, be offset by raising the productivity of workers through education and training.

The effects of an aging labour force may be more significant in an economy experiencing rapid structural changes. In such an economy, the depreciation rate of human capital in terms of technology-specific skills is expected to be high, as new jobs created may require skills that are different from those required by jobs that have been lost. This effect is likely to be more pronounced for older workers who may have invested in job- or technology-specific skills, and face difficulties in picking up new skills. The increase in the rate of depreciation of the technology-specific human capital of older workers could thus dampen overall productivity growth in the economy.

Singapore's economy is a prime example of an economy that has experienced rapid structural changes over the years. Given the relentless push of globalisation and technological

[1] Shantakumar. G, "Productivity and Labour Supply in Singapore", Economic Policy Management in Singapore, ed. Lim C. Y., (Addison Wesley, 1996).

advances, the rate of structural changes in Singapore could accelerate in the future, as firms are forced to compete even more aggressively in the global market to survive. In view of the twin challenges of an aging population and a rapidly changing economic environment, it is important for us to study the impact of aging on productivity and economic growth in Singapore, as well as the associated policy implications.

Apart from age, the educational level of workers is another important factor that would change the quality of workers over time, and thus have an impact on labour productivity. For instance, for a given number of hours of work, the contribution of an educated worker to output is normally higher than that of a less educated worker, since it has been shown that the ability to implement and absorb new technologies increases with general education[2]. Conversely, for the same number of hours of work, an older worker with sufficient on-the-job experience will be able to contribute more to output than a young unskilled worker[3]. In Singapore, the educational profile of the labour force is improving even as its age profile is shifting towards older workers. This is due to the inflow of better educated younger workers into the labour force, and the outflow of less educated older workers through retirement. Hence, in order to have a clearer understanding of the key drivers of labour productivity growth, we have to separate the effects of the changing educational profile of workers on productivity growth from the effects of the changing age profile.

Existing studies on the effects of age and education on productivity growth are scarce. Based on a study on the Canadian economy, Chinloy (1989) does not find any significant contribution of workers by different age categories to labour productivity growth. However, he finds that workers by different educational groups have positive contributions to labour

[2] See Bartel, Ann and Frank Lichtenberg, 1987. "The Comparative Advantage of Educated Workers in Implementing New Technologies", Review of Economics and Statistics 69 (1) (1987): 1-11; Clark, R. and Splengler J., The Economics of Individual and Aging Population,(Cambridge, Mass.: Cambridge University Press, 1980).

[3] Becker, Gary, "Investment in Human Capital: A Theoretical Analysis", Journal of Political Economy 70 (supplement) (1962): 9-49.

productivity growth, with the educated workers contributing more to labour quality and productivity growth. Medoff and Ibrahim (1980) find positive effects of age on productivity growth, but their findings also reveal that age contribution to productivity growth only increases up to a certain age, normally between 55 to 60 years, and declines thereafter. However, Lazear (1990) suggests that aging will have real effects on average productivity, although the direction of change will depend on factors such as the complementariness between factors of production in the production function. In a more recent study on the U.S. economy, Ho and Jorgenson (2001) report that quality improvements of the labour force in terms of age and education contributed nearly 40 percent to the growth of total labour input. Most of the contribution came from improvements in education.

Imamura (1990) measures the quality change of labour input for Japan from 1960 to 1979, and finds that the age contribution of workers to productivity growth is more significant than the education contribution of workers. The studies by Koike (1988), Hashimoto and Raisan (1985) and Mincer and Higuchi (1988) highlight the importance of on-the-job training and development of firm-specific skills for Japanese male workers. However, Ohtake (1998) re-examined the above impact on older workers, and report that the return to tenure in the Japanese labour force is smaller than what was reported earlier.

In a recent study, Thangavelu and Abe (2003) examined the impact of structural changes on productivity growth on the Singapore economy, taking into account the educational and age composition of the workforce at the aggregate and sectoral levels from 1983 to 1999. Their results at the aggregate level indicate that older workers with degree education are getting more productive as the economy transits towards more skilled and knowledge-intensive production. However, the results by sectors suggest that the quality change for older workers is much lower in a sector with rapid structural changes such as the manufacturing sector, as opposed to the services sector which tends to be more structurally

stable. In contrast, the quality change through education is more stable across sectors and has contributed positively to labour productivity growth over time.

This paper extends the study by Thangavelu and Abe (2003) with more recent data on the age and educational composition of the Singapore workforce. It studies the effects of the changing age and educational composition of the workforce on productivity growth in the Singapore economy. A labour quality index is constructed to estimate the effects of different age and educational groups on labour productivity growth. In order to differentiate the impact of age and education, separate quality indices by the education and age characteristics of workers are derived. Finally, the paper includes simulations on how changes in labour quality by age and education can affect productivity growth in Singapore. Policy implications are then drawn.

Similar to the earlier paper by Thangavelu and Abe (2003), the results of this paper suggest that quality change through education is the key driving force for labour productivity growth in the Singapore economy. In particular, workers with degree education contribute the most to labour productivity growth. The results also suggest that the growth in the labour quality of workers by age, and hence, its contribution to productivity growth is falling. Of particular concern is the rising negative impact of workers in the 55 and above age group on labour quality and productivity growth. The simulation results clearly show that unless more is done to improve labour quality growth through education and/or to arrest the fall in labour quality growth by age (especially in the case of older workers who are aged 55 and above), labour productivity growth in Singapore could fall in the years ahead. This will have obvious repercussions on Singapore's economic competitiveness and growth.

The paper is organised as follows. In section 2, we provide an overview of the key demographic trends affecting the labour force in Singapore, and the structural changes that have occurred in the economy. Section 3 describes the methodology and data. In section 4,

results on the quality effects of the workforce by age and education groups, and their impact on labour productivity growth are provided. In section 5, we report the results of the simulations on changes in labour quality by age and education. Section 6 concludes, and provides some policy implications from the study.

2. Key Demographic Trends and Structural Changes in Singapore

2.1 Key Demographic and Labour Force Trends

As in most developed countries, the age structure of the population in Singapore is changing due to falling fertility and mortality rates. Shantakumar's work[4] reveals the extent of the changing age structure in Singapore. In particular, Shantakumar (1996) reports a falling youth dependency ratio and a rising old-aged dependency ratio since 1966, which clearly reflects the aging of the resident population in Singapore.

In 2004, out of the 3.4 million people aged 15 and above in Singapore, about 1.2 million males and 980,000 females were in the labour force. Although Singapore has one of the highest overall labour force participation rates (LFPR) among countries such as the United Kingdom, Hong Kong, South Korea, Japan, China, and Taiwan, the participation rate of older persons and mature women in Singapore still tends to lag behind other countries. Chart 1 in Appendix 1 shows the LFPR of males and females in Singapore. While a high percentage of Singapore women are economically active when they are in their 20s, their participation rate declines with age. The absence of a second peak hints at the difficulty that women face in re-entering the workforce after childbirth, possibly due to the lack of family-friendly work arrangements. Nevertheless, in recent years, there are signs of a rise in the participation rates of older women aged between 45 and 64. Their increased participation is likely to have been driven by a need to supplement their family income amidst difficult economic conditions.

[4] See Shantakumar, G (1996).

Even with the current levels of LFPR, the labour force is already showing signs of aging. Table 1 below shows the changing age composition of workers in Singapore. In 1984-1994, the share of workers between 15 to 29 years old was 40 percent, but this fell to 27 percent in 1995-2004. On the other hand, the share of older workers aged 40 and above increased from 30 percent in 1984-1994 to 43 percent in 1995-2004. Corresponding to this aging profile, the median age of workers rose to 38.8 years in 2004, up from 35.1 years a decade ago.

Table 1: Changing Age Composition of Workers in Singapore (%), 1984-2004

	15-29 yrs	30-39 yrs	40 yrs and over	Total
1984-1994	39.8	30.1	30.1	100.00
1995-2004	27.2	30.3	42.5	100.00

Source: Labour Force Survey, various issues, Ministry of Manpower, Singapore

In the years ahead, more older workers and women may stay on for a longer time in the labour force, given the expected rise in life expectancy and the need to ensure an adequate amount of savings for retirement. With the rising LFPR of older persons, and coupled with a low fertility rate, we can expect the greying of the labour force to continue.

As for the educational profile of the workers, there has been a distinct improvement in the profile over the years (see Table 2). The proportion of workers with no formal or primary and lower education fell from 48.9 percent in 1984-1994 to 35.5 percent in 1995-2004. In contrast, the proportion of workers with post-secondary / diploma, and degree education increased from 20.7 percent in 1984-1994 to 36.2 percent in 1995-2004.

Table 2: Changing Education Composition of Workers in Singapore (%), 1984- 2004

	No formal	Primary or Lower	Secondary	Post-Sec / Diploma	Degree	Total
1984-1994	18.7	30.2	30.3	14.1	6.6	100.00
1995-2004	14.1	21.4	28.3	20.5	15.7	100.00

Source: Labour Force Survey, various issues, Ministry of Manpower, Singapore

2.2 Structural Transformation in the Singapore Economy

The Singapore economy has undergone several major structural changes over the years. Since the 1970s, the economy has constantly adjusted its manufacturing industrial structure to higher value-added production to maintain competitiveness in the global economy[5]. In the 1980s, the economy adjusted its industrial structure from labour and capital-intensive production to capital-skilled intensive production. In the 1990s, to maintain competitiveness and to offset the "hollowing-out" effects from the re-location of multinational corporations, the manufacturing sector shifted towards more skilled and knowledge-based activities. In recent years, the services sector has also become more important. In 1999-2004, the services sector accounted for nearly 65 percent of nominal GDP, while the manufacturing sector only accounted for 25 percent.

Against this backdrop of rapid structural changes, workers, especially the older ones, may find it more difficult to keep their skills relevant to the needs of the economy. This will have significant implications for overall productivity growth in the economy.

3. Growth Decomposition by Age and Education: Methodology and Data

3.1 Methodology

The growth accounting framework, as proposed by Chinloy[6], is used to analyse the effects of the age and education composition of the labour force on productivity growth in Singapore. Based on the assumption that there exists an index of labour inputs separable

[5] See Rao, Bhanoji and C. Lee, "Sources of Growth in Singapore Economy and its Manufactuirng and Service Sectors", Singapore Economic Review (1995), Vol. 38, No. 2: 231-251; Young, Alwyn, "A Tale of Two Cities: Factor Accumulation and Technical Change in Hong Kong and Singapore", ed. Oliver Blanchard and Stanley Fisher, NBER Macroeconomics Annual 1992, Cambridge, MA: MIT Press 1992); Young, Alywn, 1995. "The Tyranny of the Numbers: Confronting the Statistical Realities of the East Asian Growth Experience." Quarterly Journal of Economics (1995): 641-680.

[6] See Chinloy, Peter (1989).

from other factors of production such as capital and material inputs, a quality index for labour inputs is constructed. In addition, the model also assumes that the labour inputs, which are disaggregated in terms of their age and education characteristics, are paid the value of their marginal products.

The production function is defined as:

$$Y = f(D, X_{L+1}, ..., X_N, A), \qquad (1)$$

where Y is the quantity of output, X_{L+i} is non-labour inputs, and A is the technology variable. The labour input index is defined by $D = D(X_1, X_2 .... X_L)$ with X_i types of labour inputs.

The total employment in the economy is defined as:

$$E = \sum X_i,\ i = 1, ..., L \qquad (2)$$

and total compensation as:

$$C = \sum X_i W_i\ , \qquad (3)$$

where W_i is the unit wage for the i^{th} labour input. The labour compensation share (s_i) is given as: $s_i = \frac{X_i W_i}{C}$.

Given the assumption of competitive markets and linear homogeneity of the production function, we can equate the elasticity of D with respect to X_i to the labour compensation share s_i. In this case, the growth rate of the labour input index (d) is given by: $d = \sum s_i x_i$, where x_i is the growth rate of labour input i. Since the input index is assumed to be linearly homogenous, it can be expressed as:

$$D = ED^*(\frac{X_i}{E}, \frac{X_2}{E}, ... \frac{X_L}{E}) = ED^*(b_1 .... b_L), \qquad (4)$$

where D* is the index of labour quality and b_i is the employment share. The quality index is redefined as:

$$D^*(b_1.....b_L) = \frac{D}{E}, \qquad (4`)$$

As in the compensation share, the employment share too will sum to one. The interpretation of the quality index is that if D* equals to one, the total labour inputs is equal to total employment, and there is no difference in quality across the different types of labour inputs. However, if the quality of contribution of workers in terms of education and skills is higher than the actual employment, the labour quantity index will be greater than the total employment. In this case, the quality index will be greater than one and the contribution of workers to output will be underestimated if only actual employment is taken into account in the decomposition of output growth.

The total employment can also be expressed in growth rates: $e = \sum b_i x_i$. The growth rate in labour quality (d*) is the difference between the growth rate of labour quality index (d) and employment growth rate:

$$d^* = \sum (s_i - b_i) x_i = \sum q_i x_i \, . \qquad (5)$$

The quality weight is given by $(s_i - b_i)$ for input *i*. The quality weight of the i^{th} type of worker consists of his compensation share (s_i) and employment share (b_i). The quality weight will be positive when the compensation share exceeds the employment share of the i^{th} unit of labour. The contribution to labour quality by the i^{th} labour input is given by the product of the quality weight and the employment growth rate for the i^{th} labour input.

Applying the growth accounting framework, output growth (y) can be expressed as:

$$y = s_L (e + \sum_{i=1}^{L} q_i x_i) + \sum_{i=L+1}^{N} v_i x_i + a \, , \qquad (6)$$

where s_l is the labour share, v_i is the share of other non-labour inputs[7], and a is total factor productivity (TFP) growth. The output growth is decomposed into three components: labour input growth consisting of growth in employment and labour quality; non-labour inputs growth; and TFP growth. This equation can be rewritten as labour productivity growth:

$$y - e = s_L \sum_{i=1}^{L} q_i x_i + \sum_{i=L+1}^{N} v_i (x_i - e) + a \,. \qquad (7)$$

The above framework also allows one to decompose the effects of aging and education on labour productivity growth through the labour quality index. The effects of education and age on labour productivity growth can be observed if we construct separate quality effects for age and education.

The growth of labour quality by age can be constructed in the following manner. Let j represent characteristics of employment by age and h represent characteristics of employment by education. The total employment by age is given by summing over the educational groups:

$$X_j = \sum_{h}^{H} X_{jh}, \qquad j = 1,.....,J \qquad (8)$$

and total employment by education is given by summing over the age groups:

$$X_h = \sum_{j}^{J} X_{jh}, \qquad h = 1,.....,H \qquad (9)$$

The contribution of a given age group to labour quality is given as:

$$z_j = q_j x_j, \qquad j = 1,.....,J \qquad (10)$$

and the contribution of a given educational group to labour quality is given as:

$$n_h = q_h x_h, \qquad h = 1,.....,H \qquad (11)$$

[7] With constant returns to scale and competitive market assumption, we will have: $1 - s_L = \sum v_i$.

where the labour quality weights, q_j and q_h, are constructed as in equation (5). In this case, the growth in labour quality is the sum of the contribution of education and age:

$$d^* = \sum_j z_j + \sum_h n_h \,. \qquad (12)$$

and labour productivity growth is expressed analogous to equation (7):

$$y - e = s_L \left[\sum_{j=1}^{J} z_j + \sum_{h=1}^{H} n_h \right] + \sum_{i=L+1}^{N} v_i (x_i - e) + a \,. \qquad (13)$$

3.2 Data Requirements

This study uses annual data from 1983 to 2004, since data on the age and education composition of workers is only available from 1983 onwards. The data for capital investments, value-added output, output price deflators, and capital stock price deflators is collected from the *Yearbook of Statistics, Department of Statistics, Singapore* (various issues). The data for employment and gross monthly income by age and education (see Table 3) is obtained from the *Labour Force Surveys* and *Profile of the Labour Force of Singapore, Ministry of Manpower, Singapore* (various issues). As the gross monthly income by age and education is given in income ranges[8], we used the mean gross monthly income within each range to calculate the gross compensation for workers by age and education.

Table 3: Categories of Labour Input Data

Age Group	Highest Qualification Attained	Mean Gross Monthly Income
15-24	- Never attended school/Incomplete	$500
25-29	Primary	$700
30-39	- Primary/Incomplete Secondary	$900
40-44	- Secondary	$1250
45-54	- Post Secondary/Diploma	$1750
55& over	- Degree	$2250
		$2750
		$5000 & over

[8] For example, gross income is given as $400-$599, $600-$799, $800-$999, $1000-$1499, $1500-$1999, $2000-$2499, $2500-$2999, $3000 & over.

The data for capital stock is obtained from Rao and Lee[9], and is only available up to 1993. We estimated the capital stock data up to 2004 by using the perpetual inventory method with the depreciation rates given in Rao and Lee.

4. Results: Changing Age Composition, Education and Productivity Growth at Aggregate Economy Level

4.1 Quality Effects of Workforce by Age and Education

The changes in the quality of the workforce by age and education for the Singapore economy are given in Table 4. As the Asian financial crisis which struck in late 1997 is a watershed event marking the onset of a period of greater economic volatility, we have chosen to present the results for two time periods in the paper: the pre-crisis period of 1984-1997, and the post-crisis period of 1998-2004. More detailed results for shorter 5-year time periods are given in Appendix 1.

Table 4: Quality Effects of Workforce by Age and Education from 1984 to 2004

Quality Effects by Age (%)						
Age / Year	**15-29**	**30-39**	**40-44**	**45-54**	**55 & over**	**Total**
1984-1997	0.232	0.279	0.208	0.141	-0.037	0.822
1998-2004	0.001	0.009	0.032	0.046	-0.081	0.007
1984-2004	0.155	0.189	0.149	0.109	-0.052	0.551
Quality Effects by Education (%)						
Edu / Year	**No Formal**	**Primary or Lower**	**Secondary**	**Post-Sec/ Diploma**	**Degree**	**Total**
1984-1997	-0.049	-0.106	-0.021	0.393	1.169	1.387
1998-2004	-0.016	0.148	0.023	0.158	1.020	1.332
1984-2004	-0.038	-0.022	-0.006	0.315	1.119	1.369

Comparing the changes in labour quality by age groups across time, it is clear that the contribution to labour quality growth of all age groups has declined significantly in the post-crisis period when compared to the pre-crisis period. This suggests that in times of greater

[9] See Rao and Lee (1995).

economic volatility, the rate of depreciation of the technology-specific human capital of workers could be higher across all age groups, as many workers, regardless of age, may be forced by economic circumstances to take on new jobs requiring different skills.

The results also show that in 1984-1997, workers aged 39 and below contributed more to labour quality improvements than workers above the age of 40. The combined quality effect of the 15-29 and 30-39 age groups in 1984-1997 at 0.511 percent exceeded the combined quality effect of workers between 40 to 54 years old at 0.349 percent. However, in the post-crisis period of 1998-2004, the combined quality effect of workers aged 39 and below at 0.010 percent was lower than that for workers aged 40 to 54 at 0.078 percent. The relatively better performance of the older workers aged 40 to 54 years old during a period of greater economic volatility may seem counter-intuitive. However, if we consider the fact that many workers in this age group have relatively low levels of education, this trend could be partly attributed to the success of the Singapore Government in re-training less educated workers so that they remain productive and relevant to the needs of the economy. The training that the workers received could have shored up their level of productivity, and hence, helped to moderate the decline in their quality effects. The role of training in improving labour quality will be further elaborated upon in the analysis on the changes in labour quality by education.

It is also interesting to note that the contribution of workers aged 55 and above to labour quality improvements was negative in both the pre- and post- crisis periods. This shows that the value of workers to employers tends to fall once they are 55 years and above, either because the workers have become less productive with age or for other reasons. In contrast to the case of workers between 40 and 54 years old, existing training programmes targeted at older, less educated workers do not appear to have a noticeable impact on workers aged 55 and above in terms of raising their labour quality. Given the rising employment share of

workers in this age group, an increasing drag on labour quality improvements can thus be observed across the years.

As for the quality effects by educational groups, it is obvious from Table 4 that the post-secondary and above educational groups are the most significant contributors to labour quality growth. Particularly of note is the contribution of workers with degree education, which was consistently above one percent. This strongly indicates the importance of 'knowledge', or the accumulation of human capital, for the growth of the economy.

Comparing the changes in quality by education across the years, it is noteworthy that the contribution to labour quality growth of workers with secondary and below education has increased in the post-crisis period. In particular, the quality effects of workers with secondary and primary or lower education have rebounded from negative territory, with their respective quality effects rising from -0.021 percent and -0.106 percent in 1984-1997 to 0.023 and 0.148 in 1998-2004. In contrast, even though workers with post-secondary and above education continue to contribute the most to labour quality growth, their quality effects have shown a declining trend over time. In 1984-1997, the quality effect of workers with post-secondary/diploma education was 0.393 percent, but this more than halved to 0.158 percent in 1998-2004. Similarly, the quality effect of workers with degree education fell from 1.169 percent in the pre-crisis period to 1.020 percent in 1998-2004.

The improving quality effect of the less educated workers could be the result of the Government's efforts to enhance their productivity and employability, particularly through skills-based training programmes. Such efforts were stepped up during the post-crisis years, given the Government's concerns about the employability of the less educated workers in a volatile economic environment. A summary of the key workforce development programmes and initiatives that have been put in place is given in Appendix 2. A few observations can be made regarding these programmes and initiatives. First, many of the skills-based training

programmes are targeted at older and less educated workers. Comparatively, there are fewer programmes that are targeted at the more educated ones. Second, while a number of the programmes continue to focus on industry- or job-specific training, there has been an increase in emphasis in recent years on generic skills training to improve the workers' employability across occupations and industries. Third, apart from ramping up efforts to re-train workers, the Government has also embarked on a parallel effort to encourage companies to re-design jobs undertaken by Singaporeans so as to raise the productivity of these jobs (e.g., through use of machinery or the re-design of work processes).

The improving quality effect of the less educated workers seems to suggest that the Government's efforts may have been successful in raising their productivity through skills training and job re-design efforts. At the same time, however, the decline in the quality effects of the better educated workers over time may be a cause for concern. Such a trend suggests that even higher educated workers could see a more rapid erosion of their technology-specific human capital during times of greater economic volatility and uncertainty, as they may be forced to take on new jobs requiring different skills sets when their old jobs disappear. Although the Government's re-training efforts should rightly still be focused on the less educated workers, this trend highlights the need to consider more ways to encourage and help the better educated workers keep their skills relevant to the changing needs of the economy.

4.2 Contribution of Labour Quality to Productivity Growth

The contribution of workers by age and educational groups to labour productivity growth is given in Table 5. Not surprisingly, the results show the same trends as those observed for the quality effects by age and education. In terms of the contribution by age, younger workers below 39 years old contributed more to labour productivity growth than older

workers aged 40-54 in 1984-1997. The contribution of workers below 39 years old to productivity growth was 0.198 percent, compared to 0.129 percent for those between 40 and 54 years old. In 1998-2004, the contribution of those aged 40-54 to productivity growth became greater than that for younger workers, given their higher quality effects as described in the previous section. However, workers aged 55 and above had exerted a dampening effect on overall productivity growth, particularly in 1998-2004. In the years ahead, as the share of workers aged 55 and above continues to rise with the aging of the labour force, we could see an increasing negative impact on productivity growth.

Table 5: Contribution of Workers to Productivity by Age and Education Groups from 1984 to 2004

Contribution to Productivity by Age (%)						
Age / Year	**15-29**	**30-39**	**40-44**	**45-54**	**55 & over**	**Total**
1984-1997	0.090	0.108	0.077	0.052	-0.013	0.315
1998-2004	0.003	0.004	0.011	0.016	-0.028	0.006
1984-2004	0.061	0.073	0.055	0.040	-0.018	0.212
Contribution to Productivity by Education (%)						
Edu / Year	**No Formal**	**Primary or Lower**	**Secondary**	**Post-Sec/ Diploma**	**Degree**	**Total**
1984-1997	-0.007	-0.038	-0.008	0.151	0.450	0.549
1998-2004	-0.004	0.052	0.007	0.055	0.356	0.466
1984-2004	-0.006	-0.008	-0.003	0.119	0.418	0.521

In terms of the contribution of workers by educational groups, the results show that workers with degree education contributed the most to labour productivity growth. Their contribution tends to be much higher than that of other educational groups. This once again underscores the importance of education and 'knowledge' human capital in the knowledge-based economy.

A comparison of the total contribution to labour productivity growth of workers by age groups to the total contribution of workers by educational groups across time reveals interesting trends. First, the total contribution of workers in different age groups to labour

productivity growth was much lower than the total contribution of workers in the different educational groups in both time periods. Second, the total contribution of workers by age to productivity growth had fallen dramatically from 0.315 percent in 1984-1997 to 0.006 percent in 1998-2004. In contrast, the total contribution to productivity growth of workers by education had generally remained high, averaging about 0.5 percent. These trends suggest that quality change through education is the key driver of labour productivity growth, and that the raising of labour quality through education could be an effective way of countering the negative impact of an aging labour force on productivity growth.

The sources of labour productivity growth for Singapore are summarised in Table 6 below. In 1984-1997, the growth in capital per worker contributed to 53 percent of labour productivity growth. The contributions from improvements in labour quality and TFP were lower at 13 percent and 34 percent, respectively. In the post-crisis period, the relatively sluggish output growth had led to lower labour productivity growth overall. Whilst the contribution from improvements in labour quality to labour productivity growth remained lower than the contribution from the growth of capital per worker, the size of its contribution had grown to 22 percent. TFP growth in the post-crisis period was slightly negative, largely due to the economic setbacks caused by the Asian financial crisis and the September 11 crisis. Chart 2A in Appendix 1 shows the TFP growth and GDP growth for Singapore in 1984-2004. It is not surprising to see the TFP growth rate following closely the trend in GDP growth rate. The Asian financial crisis (in late 1997) and the September 11 crisis (in 2001) caused both GDP and TFP growth to plummet. With the exception of a small dip in 2003 due to the SARS crisis, TFP growth has been on an upward trend since 2001, in line with the economic recovery. See Chart 2B in Appendix 1 for a depiction of the trends in TFP growth in the post-crisis period.

Table 6: Sources of Labour Productivity Growth in Singapore from 1984 to 2004 (%)

	Growth Rate of output	Growth Rate of Labour Prod.	Growth Rate of Capital Stock	Labour Share	Contribution from Growth Rate of Capital per worker $((x-e)(1-s_L))$	Contribution from Labour Quality $(d^*(s_L))$	TFP Growth
1984-1997	9.89	6.94	8.91	37.88	3.71	0.86	2.37
1998-2004	3.83	2.07	4.39	34.83	1.68	0.47	-0.09
1984-2004	7.87	5.32	7.40	36.86	3.03	0.73	1.55

5. Results of Simulations on Changes in Labour Quality

This section reports the results of the simulations on changes in labour quality by age and education on productivity growth in Singapore. The baseline results are taken to be the average growth rates in labour productivity, labour quality by age and education, capital per worker and TFP achieved over the entire period of analysis, i.e., 1984-2004. By simulating changes in labour quality by age and education, while holding the growth rates of capital per worker and TFP, as well as the average compensation share of labour inputs constant at the baseline level, we can explore how such changes may affect labour productivity growth in the years ahead.

Three main scenarios are explored in this simulation exercise:

(i) **Scenario 1** – Growth in labour quality by age declines, while growth in labour quality by education remains unchanged. As such a scenario could happen with an aging labour force, it would be interesting to examine the impact of a sustained fall in the growth rate of labour quality by age on productivity growth. Here, we simulate the effects of a fall of 25%, 50% and 75% in the growth rate of labour quality by age.

(ii) **Scenario 2** – Growth in labour quality by age continues to decline, while growth in labour quality by education increases. This scenario is to explore the extent to

which improvements in labour quality through education can compensate for the lower growth in labour quality by age caused by an aging labour force. Again, we simulate the effects of a fall of 25%, 50% and 75% in the growth rate of labour quality by age, but this time, the falls are accompanied by increases of 25%, 50% and 75% in the growth rate of labour quality by education.

(iii) **Scenario 3** – This is the best case scenario, in which the growth rates of labour quality by age and education both increase by 25%, 50% and 75%.

The results of the simulation exercise are provided in Table 7.

Table 7: Simulations on Impact of Changes in Labour Quality by Age and Education on Labour Productivity Growth in Singapore (%)

	Growth Rate of Labour Quality by Age	Growth Rate of Labour Quality by Education	Labour Productivity Growth
Baseline	0.55	1.37	5.32
Scenario 1	↓ 25%	Unchanged	↓ 1.44%
	↓ 50%	Unchanged	↓ 2.39%
	↓ 75%	Unchanged	↓ 3.35%
Scenario 2	↓ 25%	↑ 25%	↑ 0.93%
	↓ 50%	↑ 50%	↑ 2.35%
	↓ 75%	↑ 75%	↑ 3.77%
Scenario 3	↑ 25%	↑ 25%	↑ 2.84%
	↑ 50%	↑ 50%	↑ 6.17%
	↑ 75%	↑ 75%	↑ 9.50%

The simulation results clearly show that if nothing is done to arrest the fall in the growth rate of labour quality by age or to further improve labour quality by education (i.e., Scenario 1), labour productivity growth will decline in the years ahead. This would have an adverse impact on Singapore's economic competitiveness and growth. If, however, greater efforts are made to improve the labour quality by education and these efforts are successful (i.e., Scenario 2), the improvements in labour quality by education can help to compensate for the

fall in growth rate of the labour quality by age. In fact, if the magnitude of increase in the growth rate of labour quality by education (in percentage terms) is the same as the magnitude of decline in the growth rate of labour quality by age, the negative pull on labour productivity growth caused by the latter can be reversed. Finally, if the growth rates in labour quality by age and education can both be improved upon (i.e., Scenario 3), there will be a greater boost to labour productivity growth.

6. Policy Implications and Conclusion

This paper has examined the impact of changes in labour quality by education and age on labour productivity growth in the Singapore economy. Overall, the results suggest that the growth in labour quality by age has declined rapidly. This is largely caused by the aging of the labour force, coupled with an increase in the depreciation rate of the technology-specific human capital of workers across all ages in an environment of greater economic volatility. Of particular concern is the rising negative impact of workers in the 55 and above age group on labour quality and hence, labour productivity growth. On the other hand, the contribution of workers in the 40-54 age group to labour quality and productivity growth has overtaken that of younger workers. This could be partly attributed to the success of the Government's efforts in re-training older, less educated workers so that they remain productive and relevant to the needs of the economy.

The results also clearly indicate that while the aging of the labour force will have an impact on labour quality, education is still the key driver of labour quality improvements and productivity growth in Singapore. Workers with degree education have been found to contribute the most to labour quality and labour productivity growth. This strongly suggests that having a highly educated workforce will be very important in helping Singapore to sustain its economic growth in the long term, especially as the economy moves towards a

'knowledge-based' economy. Another interesting result is the observed improvement in the quality effect of the less educated workers, possibly due to the success of training and job re-design programmes put in place by the Government to enhance their productivity and employability. Worryingly though, the quality effect of the better educated workers, whilst still higher than that for the less educated workers, has declined over the years. This could be a signal that even educated workers would suffer from a faster rate of erosion of their human capital during periods of economic volatility and uncertainty.

Finally, the results from the simulations show that unless more is done to improve labour quality growth through education and/or to arrest the fall in the growth rate of labour quality by age, we could see a decline in labour productivity growth in the years ahead. This would adversely affect Singapore's economic competitiveness and growth.

Given the above findings, the main policy implications that can be drawn from this study are as follows:

(i) To mitigate the potential negative impact of an aging labour force on labour productivity growth, it is important for the Government to continue to focus on life-long learning and the re-training of older and less educated workers, as this will help the workers to remain relevant and productive in the domestic economy. In this regard, the Government should continue to look into increasing the opportunity for older workers to acquire general education, e.g., in employability skills. This is because having a more general education will allow older workers to be more mobile across different sectors and occupations, and reduce the rate of depreciation of technology-specific human capital. In view of the rapid structural changes taking place in the economy, a key challenge is to determine the right combination of general education and technology-specific training for workers. With sustained efforts in the training of older workers in both specific and generic skills, the

Government can help to improve their labour quality and hence, raise productivity growth. In this regard, special emphasis may have to be placed on workers aged 55 and above, given that their labour quality effects are observed to be negative and declining. Additionally, the Government can step up its efforts to encourage companies to re-design jobs that less educated Singaporeans, particularly the older ones, are engaged in so as to raise the productivity of these jobs.

(ii) As education is the key driving force for labour quality improvements and productivity growth, the Government should continue to push ahead with its plans to raise the educational profile of Singaporeans, particularly in terms of increasing the number of tertiary graduates. The Government's target is to increase the percentage of each cohort of Singaporeans entering local universities from the 20% in 2002 to 25% in 2010. A continuing improvement in the educational profile of the workforce will help to raise Singapore's labour productivity growth in the future.

(iii) Although the Government's training efforts should rightly still be focused on the less educated and older workers, the results of the study also suggest that there may be a need to consider ways to encourage and help the better educated workers to keep their skills updated and relevant to the changing needs of the economy.

Singapore has come a long way since its independence. It has managed to sustain a generally high level of economic growth on the back of sound Government policies implemented over the years. One of the key challenges facing Singapore now is how to manage the impact of an aging population on labour productivity, and hence, economic growth. This study has re-affirmed the need for the Government to focus on education, as well as the training of older workers in order to enhance the labour force's productivity and employability.

References

Bartel, Ann and Frank Lichtenberg, 1987. "The Comparative Advantage of Educated Workers in Implementing New Technologies", *Review of Economics and Statistics,* 69 (1), pp. 1-11.

Clark, R. and Splengler J., 1980. *The Economcis of Individual and Aging Population,* Cambridge, Mass.: Cambridge University Press.

Chinloy, Peter, 1989. "The Effects of Shifts in the Composition of Employment on Labour Productivity Growth: Canada 1971-1979", in *Applications of Modern Production Theory,* A Dogavmaci and R. Rare (editors), Kluwei Academic Publishers.

Fosgerau, M., S.E. Hougaard Jensen, and A. Sorensen, 2002. "Measuring Educational Heterogeneity and Labour Quality: A Note," *Review of Income and Wealth*, 48(2), pp. 261-269.

Hashimoto, Masanori, 1993. "Aspects of Labour Market Adjustments in Japan", *Journal of Labour Economics*, 11:1, pp. 136-161.

Ho, M.S. and D.W. Jorgenson, 2001. "The Quality of the U.S. Workforce", manuscript, Harvard University, United States.

Imamura, Hajime, 1990. "Compositional Change of Heterogenous Labour Input and Economic Growth in Japan." In *Productivity Growth in Japan and United States*, Charles Hulten ed., University of Chicago Press, Chicago, 1990.

Lazaear E. 1990, "*Adjusting to an Aging Workforce*". In *Issues in the Economics of Aging*, David Wise (ed.), University of Chicago Press.

Owyong, David and Bhanoji Rao, 1998. "Total Factor Productivity Growth in the Singapore Economy: Some Econometric Estimates", *Singapore Economic Review, 43(1), pp. 74-81.*

Rao, Bhanoji and C. Lee, "Sources of Growth in Singapore Economy and its Manufactuirng and Service Sectors", Singapore Economic Review (1995), Vol. 38, No. 2: 231-251

Shantakumar. G, "Productivity and Labour Supply in Singapore", Economic Policy Management in Singapore, ed. Lim C. Y., (Addison Wesley, 1996).

Tan, Lin Yeok and Suchin Virabhak, 1998. "Total Factor Productivity Growth in Singapore's Service Sector", *Journal of Economic Studies*, Vol. 25, No. 5, pp. 392-409.

Thangavelu, S.M. and Bhanoji Rao, 1999. "TFP Growth in the Electronic Industry", *Singapore Economic Review*, Vol. 44, No. 2, pp. 56-68.

Thangavelu, S.M. and Shigeyuki Abe, 2003. “Structural Changes and Productivity Growth in Singapore: The Quality Effects of Age and Education”. Manuscript, Department of Economics, National University of Singapore.

Young, Alwyn, “A Tale of Two Cities: Factor Accumulation and Technical Change in Hong Kong and Singapore”, ed. Oliver Blanchard and Stanley Fisher, NBER Macroeconomics Annual 1992, Cambridge, MA: MIT Press 1992).

Young, Alywn, 1995. “The Tyranny of the Numbers: Confronting the Statistical Realities of the East Asian Growth Experience.” Quarterly Journal of Economics (1995): 641-680.

Chart 1: Labour Force Participation Rates by Sex, 1994 and 2004

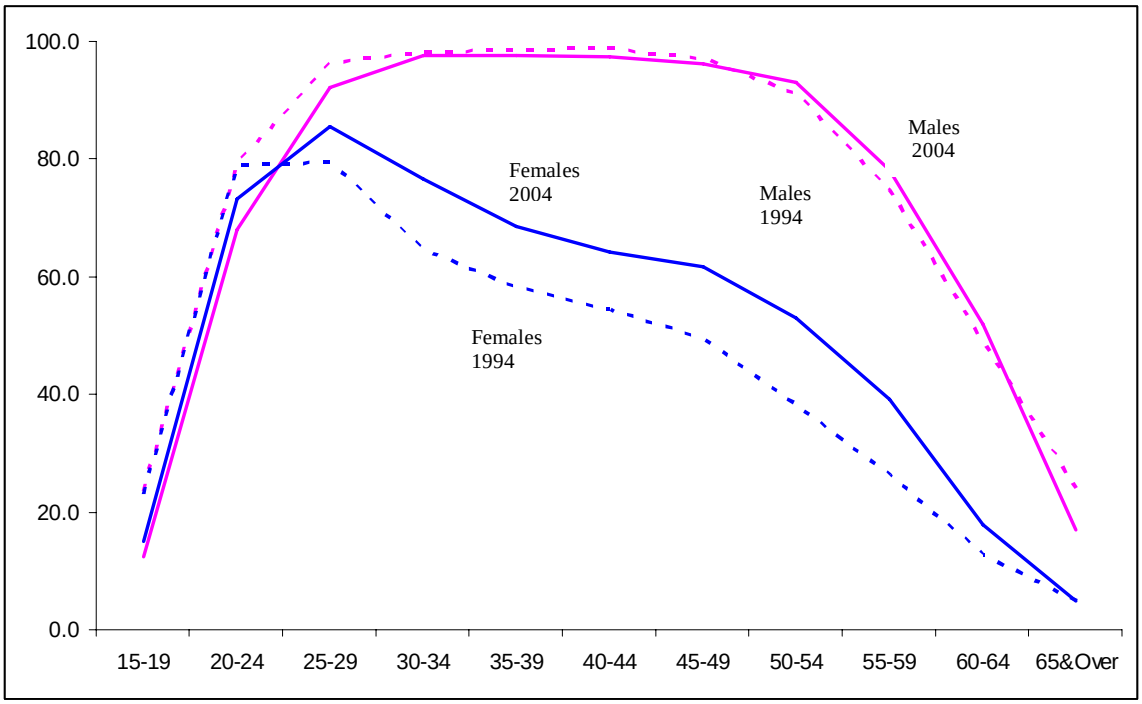

Chart 2A: Total Factor Productivity Growth, 1984-2004

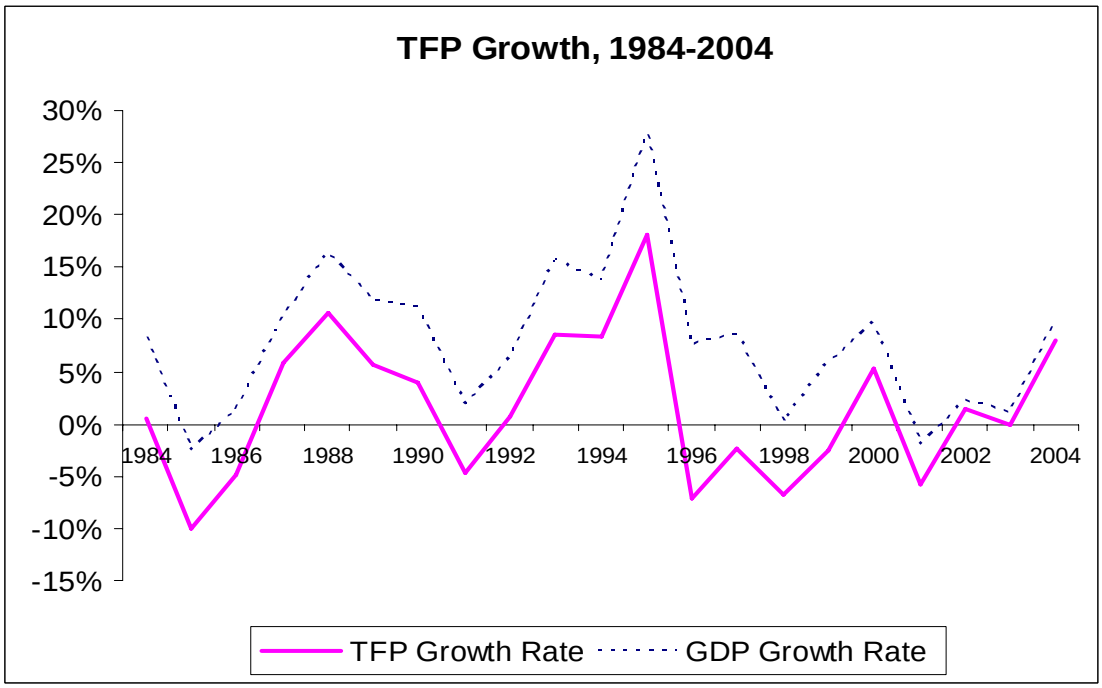

Chart 2B: Total Factor Productivity Growth in Post-Crisis Period (1998-2004)

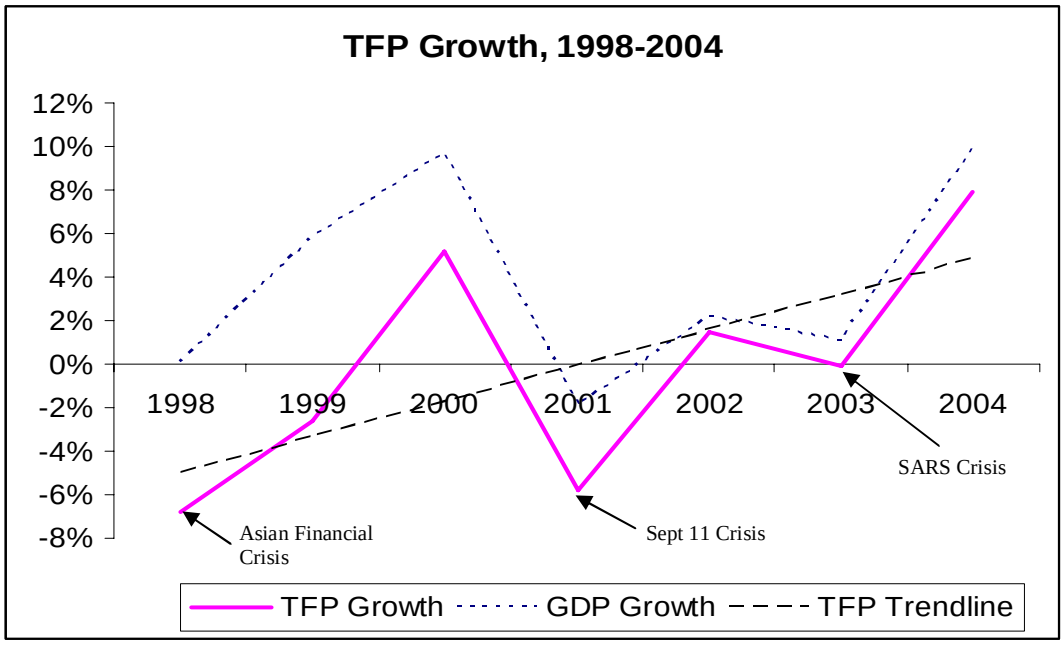

Table 1: Quality Effects of Labour Force by Age and Education from 1984 to 2004

Quality Effects by Age (%)						
Age / Year	**15-29**	**30-39**	**40-44**	**45-54**	**55 & over**	**Total**
1984-1989	0.331	0.389	0.169	0.101	-0.008	0.983
1990-1994	0.073	0.225	0.278	0.165	-0.044	0.697
1995-1999	0.250	0.112	0.116	0.126	-0.077	0.527
2000-2004	-0.070	-0.010	0.029	0.046	-0.087	-0.091
1984-2004	0.155	0.189	0.149	0.109	-0.052	0.551
Quality Effects by Education (%)						
Edu / Year	**No Formal**	**Primary or Lower**	**Secondary**	**Post Sec./ Diploma**	**Degree**	**Total**
1984-1989	0.042	-0.135	-0.006	0.359	0.710	0.971
1990-1994	0.049	-0.152	-0.030	0.431	1.438	1.737
1995-1999	-0.254	0.082	-0.022	0.309	1.392	1.509
2000-2004	-0.005	0.141	0.032	0.151	1.019	1.338
1984-2004	-0.038	-0.022	-0.006	0.315	1.119	1.369

Table 2: Contribution of Labour Force to Productivity by Age and Education Groups from 1984 to 2004

Contribution to Productivity by Age (%)						
Age / Year	**15-29**	**30-39**	**40-44**	**45-54**	**55 & over**	**Total**
1984-1989	0.140	0.155	0.064	0.040	-0.003	0.396
1990-1994	0.022	0.083	0.102	0.060	-0.016	0.251
1995-1999	0.089	0.043	0.043	0.045	-0.026	0.194
2000-2004	-0.023	-0.003	0.010	0.016	-0.030	-0.030
1984-2004	0.061	0.073	0.055	0.040	-0.018	0.212
Contribution to Productivity by Education (%)						
Edu / Year	**No Formal**	**Primary or Lower**	**Secondary**	**Post Sec./ Diploma**	**Degree**	**Total**
1984-1989	0.017	-0.049	-0.002	0.140	0.275	0.380
1990-1994	0.021	-0.058	-0.011	0.160	0.532	0.645
1995-1999	-0.066	0.035	-0.008	0.121	0.546	0.627
2000-2004	0.001	0.049	0.010	0.052	0.349	0.461
1984-2004	-0.006	-0.008	-0.003	0.119	0.418	0.521

Table 3: Sources of Labour Productivity Growth in Singapore from 1984 to 2004 (%)

	Growth Rate of output	Growth Rate of Labour Prod.	Growth Rate of Capital Stock	Labour Share	Contribution from Growth Rate of Capital per worker $((x-e)(1-s_L))$	Contribution from Labour Quality $(d^*(s_L))$	TFP
1984-1989	7.62	5.61	8.03	39.83	3.52	0.78	1.31
1990-1994	9.72	6.23	6.62	36.66	1.99	0.90	3.34
1995-1999	10.01	7.05	12.78	36.05	6.40	0.82	-0.17
2000-2004	4.18	2.31	2.05	34.31	0.12	0.43	1.76
1984-2004	7.87	5.32	7.40	36.86	3.03	0.73	1.55

Appendix 2

Summary of Workforce Development and Funding Programmes

1. The Singapore Government started to promote lifelong learning and workforce development as far back as 1979, when the Skills Development Fund was established. Since then, and especially in the light of the increased economic re-structuring and volatility seen in recent years, many more workforce development initiatives have been put in place to help workers upgrade their skills to meet the changing needs of the economy.

2. One key initiative that signals the Government's increased emphasis on workforce development is the setting up of the Singapore Workforce Development Agency (WDA) in September 2003 to drive workforce development and training initiatives in Singapore. A summary of the key workforce development/training programmes and funding schemes available under the WDA is given below.

Programme / Scheme	Description
Workforce Development / Training Programmes	
Skills Redevelopment Programme (SRP)	The SRP was jointly set up by the National Trades Union Congress (NTUC) and the Economic Development Board (EDB) in 1996 to encourage employers to send their workers, especially those who are lower skilled, less educated or more matured, to take up certifiable training and skills upgrading opportunities. The SRP is now a national funding incentive programme funded by the Singapore Workforce Development Agency (WDA) and managed by NTUC. It provides incentives for employers to send their employees for training. The incentives include: - Course Fee Support: 90% course fee support for employees aged 40 years and above with 'A' levels and below qualifications; 80% support otherwise. The funding for course fee support is from the Skills Development Fund (SDF). - Absentee Payroll: 90% of hourly basic salary capped at S$6.80 per trainee-hour for employees aged 40 years and above with 'A' levels and below qualifications; 80% otherwise. - Training Allowance: up to S$5.70 per trainee hour capped at S$1000 per month. Individuals who do not have their employers' sponsorship for the training programmes can seek assistance from self-help groups and the NTUC. These organisations will act as 'surrogate employers' and sponsor them for job-related training. There are currently more than 1500 accredited courses provided by various training providers that are eligible for SRP funding.
Critical Enabling Skills Training (CREST)	CREST is a strategic response to the knowledge economy. Its objective is to develop workers with the ability to learn continuously

	to meet changing requirements; and to think and apply the knowledge and skills acquired to innovate and enhance the competitiveness of their organisations. The 7 skills covered under CREST are: Learning to Learn; Literacy; Listening & Oral Communication; Problem-Solving & Creativity; Personal Effectiveness; Group Effectiveness; and Organisational Effectiveness & Leadership. The courses endorsed by WDA under CREST are eligible for course fee support by the SDF. Whilst CREST *per se* is not entitled for absentee payroll support, employers can receive absentee payroll support for those CREST courses that are integrated with certifiable training courses under the SRP.
Singapore Employability Skills System (ESS)	The ESS was introduced by WDA in November 2004. The objective of the scheme is to equip the Singapore workforce with generic and portable skills that will enable workers to better adapt to new job demands, work challenges and the changing work environment. The ESS comprises a set of generic employability skills to raise a worker's effectiveness and improve his work abilities. These skills complement other specific industry and occupational skills which are specialised or technical by nature. The 10 employability skills introduced thus far are: - Workplace Literacy & Numeracy - Information & Communications Technology - Problem Solving & Decision Making - Initiative & Enterprise - Communication & Relationship Management - Lifelong Learning - Global Mindset - Self-management - Workplace-related Life Skills - Health & Workplace Safety A set of competency units for each of the employability skills has been identified by WDA, and grouped into 3 series of training modules: The Workplace Literacy Series, The Workplace Numeracy Series and The Workplace Skills Series. Participants will receive formal recognition upon successful completion of each training module through the award of a Statement of Attainment (SOA). The SOA is a nationally-recognised qualification indicating the participant's ability or competence in a particular area. Upon obtaining the required SOAs in all 3 series of training modules, the participants will be awarded with a Career Readiness Certificate (CRC). The CRC is a national qualification under the Singapore Workforce Skills Qualifications (WSQ) system, which recognises the participant's achievement in attaining foundational and generic employability skills. A worker being sent for ESS training under the Singapore WSQ will

	receive course fee funding from the SDF and absentee payroll funding under the SRP.
SME Upgrading for Performance (SUPER)	SUPER was launched in September 2003 to provide holistic training assistance to encourage training among Small and Medium Enterprises (SMEs). Under this programme, SMEs will receive training course fee support of $5 per trainee hour for broad-based worker level training. Upon fulfilling eligibility criteria, SMEs will also receive 50% course fee support capped at $20 per trainee hour support for executive training. In addition, funding support will be provided for workforce training projects undertaken by industry associations to promote training to their SME members.
Strategic Manpower Conversion Programme (SMCP)	WDA has developed various SMCPs, where job seekers are first selected by potential employers before they are sent for training. These programmes are conceptualised by WDA in consultation with industry so as to train and deploy tertiary-educated Singaporeans in strategic high-growth industries. An example is the SMCP in healthcare.
Industry-specific Place and Train programmes	WDA has been developing various Place and Train programmes, where job seekers are first selected by potential employers before they are sent for training. This ensures that the job seekers receive more targeted training and are assured of a job before they begin training. Examples of programmes launched to-date include those for the Precision Engineering, Hospitality, Domestic Cleaning, Healthcare, Wafer Fabrication and Social Services sectors.
ADVANTAGE! scheme	This is a pilot scheme that aims to encourage companies to employ mature workers over 40 years old, or re-employ workers beyond the age of 62 years. ADVANTAGE! emphasises the value of mature workers that companies can leverage on. It supports various initiatives, from job redesign and automation, wage restructuring, to the employment, re-employment and retention of mature workers. The scheme provides a comprehensive incentives package of up to S$300,000 per company. The areas of assistance include: - Job Redesign Grant: Companies can seek funding of up to S$120,000 for job redesign projects that will help mature workers better fit into the workplace. The projects can include the re-designing of work scope, work processes, integration programmes, and wage re-structuring. - Training Grant: Companies can seek funding of up to $5,000 as training grant for each mature worker. The grant can be used to co-fund up to 90% of the training cost of the mature worker (includes in-centre and on-the-job training); and up to 90% of the basic salary cost while the worker undergoes training.

Funding Schemes	
Skills Development Fund (SDF)	The SDF was established in October 1979 with the institution of the Skills Development Levy (SDL) Act. The primary objective of the SDF is to encourage employers to invest in the skills upgrading of the workforce. Under the SDL Act, it is a statutory requirement for employers to make SDL contributions on employees who fall within the salary ceiling for levy contributions. With effect from 1 September 2005, the salary ceiling is S$2,000. The levy rate is 1%, and a minimum of S$2 is payable when the remuneration is less than S$200. The SDF offers incentives to encourage companies to mount training programmes for their employees. Incentives are offered on the basis of a cost-sharing principle and the training must be relevant to the economic development of Singapore. The amount of incentives that a company can obtain is not tied to their levy contribution.
Lifelong Learning Endowment Fund (LLF)	The LLF was launched in March 2001, with an initial amount of S$500 million from the Government. The LLF is aimed at enhancing the employment and employability of Singaporeans through initiatives that promote and facilitate the acquisition of skills. It provides a steady stream of funding for such initiatives. With subsequent top-ups by the Government, the fund now stands at S$2.1 billion. The Government's longer term target is to set aside S$5 billion in the LLF to provide a secure and steady stream of income to help workers upgrade and retrain.
Job Re-Design Incentives	This new scheme has been introduced by WDA to subsidise the manpower, equipment and other costs of employers embarking on pilot projects to redesign jobs. Employers can receive up to $100,000 support from the LLF for each pilot project. To be eligible for funding, the job re-design project should create new employment for Singaporean workers or increase the productivity of jobs currently undertaken by Singaporean workers. Re-design efforts that can be considered include improvements to job productivity (e.g., through use of machinery), improvements to work environment (e.g., redesign of shifts and other work arrangements to be more conducive to the local workforce), and improvements to job prospects (e.g., redesign of wage structure to allow workers to earn more with higher productivity, enhancement in career development and progression etc).

Source: Website of Singapore Workforce Development Agency at http://www.wda.gov.sg.

3. In order to facilitate adult training and raise the standards of training, WDA has also put in place frameworks to recognise and certify skills acquisition as follows:

Skills System	Description
National Skills Recognition System (NSRS)	The NSRS is a national framework for establishing work performance standards, identifying job competencies and certifying skills acquisition. It seeks to: - Establish performance standards and enhance job competencies; - Strengthen the capabilities of the workforce, enhance performance levels and help increase the competitiveness of Singapore's goods and services in the global market. - Enhance the professionalism and employability of the workforce by motivating continuous learning and the acquisition of new skills to meet changing business requirements. The system provides for the development of national skills standards that stipulate work performance, and the establishment of training and assessment centres to train and assess the competence of the workforce. Skills standards under the NSRS are developed in collaboration with industry, and are field-tested before endorsement by an Industry Skills Standards Committee. The assessment of skills competence under the NSRS is conducted through a network of approved assessment centres. The NSRS standards are recognised by government and industry.
Singapore Workforce Skills Qualifications (WSQ)	The Singapore WSQ is a robust and integrated *continuing* education and training system. As the WSQ caters to adult workers who have widely diverse training needs, it offers a wide range of certifications and qualifications. The WSQ is designed to facilitate adult learning, make skills upgrading more accessible to the workforce, and provide career progression pathways for workers. It aims to equip the workforce with the necessary employability, industry and occupational skills to remain competitive and add value to the organisation. The WSQ allows employees and job seekers to progress up the skills training ladder and move between the formal education system, lifelong learning and the higher education systems in a coherent and comprehensive framework. It facilitates continuing education and training in Singapore by catering for flexible, more open and multi-mode delivery systems. It also recognises prior learning experiences as well as programmes that are compatible with international qualification frameworks. There is strong industry involvement for the WSQ. WDA collaborates with key industry players to develop the relevant qualification titles and progression pathways based on industry and occupational needs. For each implementing industry, an Industry Skills and Training Council is set up to drive the development and validation of skills standards, assessment strategies and training curriculum for the industry. To-date, WSQs are available for: Generic Skills – ESS; Retail Industry; Training Industry; and Finance Industry.

	Under WSQ, there are seven levels of qualifications from certificate to graduate diploma. The qualifications are issued by the WDA, certifying that all training and assessment requirements for the qualifications have been satisfied and accredited under the WSQ.

Source: Website of Singapore Workforce Development Agency at http://www.wda.gov.sg.